

## SCENARIO#1 AND #2: ONLY SOURCES ARE UPSTREAM AND STORMWATER (no contribution from sediment)

How does stormwater affect sediment and fish tissue concentrations when the only other PCB source is upstream flow (i.e., NO contribution from sediments)?

The data below is arranged to coincide with the 37 model segments, as shown here:

West	1	4	7	10	13	16	19	22	25	28	31	34
Center	2	5	8	11	14	17	20	23	26	29	32	35
East	3	6	9	12	15	18	21	24	27	30	33	36
Lagoon	RM 12.0	RM 10.4	RM 10.0	RM 9.4	RM 8.3	RM 7.5	RM 6.85	RM 6.05	RM 5.35	RM 4.7	RM 4.05	RM 3.4
												RM 1.8

### SEDIMENT CONCENTRATION

Model Input (ug/kg)

West	0	0	0	0	0	0	0	0	0	0	0	0
Center	0	0	0	0	0	0	0	0	0	0	0	0
East	0	0	0	0	0	0	0	0	0	0	0	0
Lagoon												

Scenario #1 Output: Modeled mean sediment concentrations **WITHOUT** stormwater (ug/kg)

West	4.5E-06	4.5E-06	4.4E-06	4.4E-06	4.4E-06	4.3E-06	4.3E-06	4.3E-06	4.2E-06	4.2E-06	4.2E-06	5.0E-06
Center	1.8E-06	1.8E-06	1.8E-06	1.8E-06	1.8E-06	1.8E-06	1.8E-06	1.8E-06	1.8E-06	1.8E-06	1.8E-06	7.2E-07
East	4.5E-06	4.5E-06	4.4E-06	4.4E-06	4.4E-06	4.3E-06	4.3E-06	4.3E-06	4.2E-06	4.2E-06	4.2E-06	5.0E-06
Lagoon												

Scenario #2 Output: Modeled mean sediment concentrations **WITH** stormwater (ug/kg)

West	4.6E-06	4.9E-06	5.0E-06	5.5E-06	5.6E-06	5.6E-06	5.5E-06	5.5E-06	5.4E-06	5.5E-06	5.5E-06	6.7E-06
Center	1.8E-06	1.8E-06	1.8E-06	1.8E-06	1.8E-06	1.8E-06	1.8E-06	1.8E-06	1.8E-06	1.8E-06	1.8E-06	7.2E-07
East	4.7E-06	4.7E-06	4.7E-06	4.7E-06	4.7E-06	4.6E-06	4.6E-06	4.7E-06	4.8E-06	9.1E-06	1.2E-05	1.5E-05
Lagoon												

QUESTION #1: How much did the sediment concentration increase when stormwater was added to the system? [Scenario #2 minus Scenario #1]

West	1.3E-07	4.4E-07	5.7E-07	1.1E-06	1.2E-06	1.3E-06	1.2E-06	1.2E-06	1.2E-06	1.3E-06	1.3E-06	1.7E-06
Center	5.2E-11	1.7E-10	3.1E-10	5.6E-10	8.3E-10	1.1E-09	1.4E-09	1.7E-09	2.0E-09	3.1E-09	4.7E-09	3.5E-09
East	1.6E-07	2.0E-07	2.3E-07	3.0E-07	3.1E-07	3.2E-07	3.3E-07	4.1E-07	5.4E-07	4.9E-06	7.8E-06	9.8E-06
Lagoon												

QUESTION #2: What percentage of modeled sediment concentration can be attributed to stormwater? [Question #1 divided by Scenario #2]

West	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%
Center	-0.0005%	-0.0004%	-0.0004%	-0.0004%	-0.0004%	-0.0004%	-0.0004%	-0.0004%	-0.0004%	-0.0004%	-0.0004%	-0.0005%
East	-0.0002%	-0.0002%	-0.0002%	-0.0002%	-0.0002%	-0.0002%	-0.0002%	-0.0002%	-0.0002%	-0.0002%	-0.0002%	-0.0001%
Lagoon												

### TISSUE CONCENTRATION

Model Input: The model run starts with fish tissue at 0 ug/kg.

Scenario #1 Output: Modeled average tissue concentration **WITHOUT** stormwater (ug/kg)

West	5.93	5.92	5.89	5.75	5.78	5.72	5.67	5.63	5.60	5.63	5.54	6.66
Center	4.43	4.49	4.58	4.43	4.39	4.42	4.33	4.33	4.33	4.34	4.32	1.74
East	5.90	5.98	5.81	5.82	5.74	5.72	5.60	5.69	5.53	5.53	5.53	6.71
Lagoon												

Scenario #2 Output: Modeled average tissue concentration **WITH** stormwater (ug/kg)

West	5.95	6.22	6.30	6.72	6.79	6.64	6.63	6.56	6.49	6.48	6.61	8.01
Center	4.48	4.42	4.49	4.44	4.39	4.41	4.36	4.31	4.25	4.33	4.29	1.72
East	6.06	6.03	6.04	6.00	5.96	6.02	5.96	5.91	6.05	9.45	11.71	14.43
Lagoon												

QUESTION #3: How much did the fish tissue concentration increase when stormwater was added to the system? [Scenario #2 minus Scenario #1]

West	0.02	0.30	0.40	0.97	1.01	0.92	0.96	0.93	0.89	0.85	1.07	1.35
Center	0.05	-0.06	-0.09	0.01	0.00	-0.01	0.03	-0.02	-0.08	-0.01	-0.03	-0.02
East	0.16	0.05	0.23	0.17	0.22	0.29	0.35	0.23	0.51	3.92	6.18	7.71
Lagoon												

QUESTION #4: What percentage of the modeled fish tissue concentration can be attributed to stormwater? [Question #3 divided by Scenario #2]

West	0.30%	4.85%	6.41%	14.41%	14.85%	13.86%	14.48%	14.24%	13.78%	13.15%	16.16%	16.85%
Center	1.04%	-1.45%	-2.02%	0.17%	-0.11%	-0.25%	0.60%	-0.55%	-1.97%	-0.23%	-0.80%	-1.02%
East	2.56%	0.79%	3.75%	2.85%	3.74%	4.90%	5.92%	3.84%	8.51%	41.50%	52.77%	53.48%
Lagoon												

**BOLD > 5%**

**NOTE:** Several of the food web model parameters are expressed as uniform random variables, meaning their value is not fixed and changes with every iteration of the model. For this reason, and because of unexpressed uncertainty, anything less than a ~5% difference should not be considered meaningful.

## SCENARIO #4 AND #5: STORMWATER'S EFFECT AFTER SEDIMENT "HOT SPOTS" CLEANED UP

How does stormwater affect sediment and fish tissue concentrations when the only other PCB inputs are upstream flow and sediments, and sediment concentrations throughout the harbor are set at a hypothetical clean up level? [In an attempt to represent what the average sediment concentration would be if "hot spots" were cleaned up, the initial total concentration in sediment for each model segment was derived by averaging the 90th percentile of the values in all 105 model segments.]

The data below is arranged to coincide with the 37 model segments, as shown here:

West Center East Lagoon	1	4	7	10	13	16	19	22	25	28	31	34
	2	5	8	11	14	17	20	23	26	29	32	35
	3	6	9	12	15	18	21	24	27	30	33	36
	RM 12.0	RM 10.4	RM 10.0	RM 9.4	RM 8.3	RM 7.5	RM 6.85	RM 6.05	RM 5.55	RM 4.7	RM 4.05	RM 3.4

### SEDIMENT CONCENTRATION

Model Input: Observed mean sediment concentrations (ug/kg)

West	0.91	2.97	0.00	57.53	1.50	5.95	3.50	1.15	0.29	6.65	0.93	0.42
Center	0.00	0.23	0.00	0.00	0.00	0.77	5.10	0.55	0.43	0.24	0.00	0.48
East	0.42	0.61	0.00	1.06	6.24	1.35	3.54	5.09	0.40	0.00	368.07	332.31
Lagoon					8.81							

Scenario #4 Output: Modeled mean sediment concentrations **WITHOUT** stormwater (ug/kg)

West	2.86	2.77	2.77	2.77	2.77	2.77	2.77	2.77	2.98	2.98	2.98	2.77
Center	2.73	2.73	2.73	2.72	2.87	2.81	2.74	2.86	2.81	2.81	2.81	2.73
East	2.86	2.77	2.77	2.77	2.77	2.77	2.77	2.77	2.98	2.98	2.98	2.77
Lagoon					2.84							

Scenario #5 Output: Modeled mean sediment concentrations **WITH** stormwater (ug/kg)

West	2.86	2.77	2.77	2.77	2.77	2.77	2.77	2.77	2.98	2.98	2.98	2.77
Center	2.73	2.73	2.73	2.72	2.87	2.81	2.74	2.86	2.81	2.81	2.81	2.73
East	2.86	2.77	2.77	2.77	2.77	2.77	2.77	2.77	2.98	2.98	2.98	2.77
Lagoon					2.84							

QUESTION #1: How much did the sediment concentration increase when stormwater was added to the system? [Scenario #5 minus Scenario #4]

West	0	0	0	0	0	0	0	0	0	0	0	0
Center	0	0	0	0	0	0	0	0	0	0	0	0
East	0	0	0	0	0	0	0	0	0	0	0	0
Lagoon					0							

**NOTE:** In actuality, these numbers are >0 but are so small they round to zero. However, because there is considerable +/- uncertainty, they should not be treated as absolutes.

### TISSUE CONCENTRATION

Model Input: The model run starts with fish tissue at 0 ug/kg.

Scenario #4 Output: Modeled average tissue concentration **WITHOUT** stormwater (ug/kg)

West	10.49	10.38	10.35	10.08	10.07	10.10	9.97	10.06	10.50	10.38	10.18	11.24
Center	8.78	8.68	8.83	8.69	8.87	8.98	8.73	8.94	8.74	8.87	8.69	6.01
East	10.45	10.50	10.17	10.17	10.14	10.11	9.96	9.91	10.39	10.37	9.95	10.87
Lagoon					4.63							

Scenario #5 Output: Modeled average tissue concentration **WITH** stormwater (ug/kg)

West	10.37	10.61	10.62	11.13	11.13	10.90	11.20	11.12	11.18	11.30	11.17	12.42
Center	8.74	8.82	8.87	8.82	8.94	8.81	8.68	8.86	8.77	8.76	8.82	6.05
East	10.58	10.44	10.32	10.39	10.26	10.32	10.34	10.12	10.68	14.18	16.33	18.85
Lagoon					9.75							

QUESTION #2: How much did the fish tissue concentration increase when stormwater was added to the system? [Scenario #5 minus Scenario #4]

West	-0.12	0.23	0.27	1.05	1.05	0.80	1.23	1.07	0.68	0.92	0.98	1.18
Center	-0.04	0.14	0.04	0.13	0.07	-0.17	-0.05	-0.08	0.03	-0.11	0.13	0.04
East	0.13	-0.06	0.15	0.22	0.12	0.21	0.38	0.21	0.29	3.81	6.38	7.98
Lagoon					5.12							

QUESTION #3: What percentage of the modeled fish tissue concentration can be attributed to stormwater? [Question #2 divided by Scenario #5]

West	-1.17%	2.19%	2.59%	<b>9.47%</b>	<b>9.47%</b>	<b>7.37%</b>	<b>11.01%</b>	<b>9.58%</b>	<b>6.06%</b>	<b>8.17%</b>	<b>8.81%</b>	<b>9.51%</b>
Center	-0.50%	1.56%	0.46%	1.44%	0.81%	-1.92%	-0.63%	-0.90%	0.40%	-1.21%	1.45%	0.66%
East	1.18%	-0.60%	1.45%	2.09%	1.19%	2.05%	3.66%	2.11%	2.70%	<b>26.86%</b>	<b>39.06%</b>	<b>42.34%</b>
Lagoon					<b>52.52%</b>							

**BOLD > 5%**

**NOTE:** Several of the food web model parameters are expressed as uniform random variables, meaning their value is not fixed and changes with every iteration of the model. For this reason, and because of unexpressed uncertainty, anything less than a ~5% difference should not be considered meaningful.

## SCENARIO #6 AND #7: STORMWATER'S EFFECT UNDER CURRENT CONDITIONS

How does stormwater affect sediment and fish tissue concentrations when the only other PCB inputs are upstream flow and sediments, with sediment concentrations set at currently observed levels?

The data below is arranged to coincide with the 37 model segments, as shown here:

West Center East Lagoon RM 12.0	1	4	7	10	13	16	19	22	25	28	31	34
	2	5	8	11	14	17	20	23	26	29	32	35
	3	6	9	12	15	18	21	24	27	30	33	36
	RM 10.4	RM 10.0	RM 9.4	RM 8.3	37 RM 7.5	RM 6.85	RM 6.05	RM 5.35	RM 4.7	RM 4.05	RM 3.4	RM 1.8

### SEDIMENT CONCENTRATION

Model Input: Observed mean sediment concentrations (ug/kg)

West	0.910	2.971	0.000	57.530	1.501	5.947	3.501	1.152	0.289	6.650	0.934	0.415
Center	0.000	0.226	0.000	0.000	0.000	0.770	5.095	0.545	0.428	0.240	0.000	0.481
East	0.416	0.614	0.000	1.056	6.241	1.350	3.537	5.092	0.396	0.000	368.070	332.306
Lagoon					8.810							

Scenario #6 Output: Modeled mean sediment concentrations **WITHOUT** stormwater (ug/kg)

West	0.866	2.770	0.000	56.698	1.733	5.330	3.466	1.979	0.213	6.396	1.066	0.433
Center	0.000	0.228	0.000	0.000	0.000	0.729	5.016	0.547	0.426	0.241	0.000	0.456
East	0.476	0.693	0.000	1.008	6.238	1.066	3.466	4.947	0.384	0.000	367.780	330.926
Lagoon					8.402							

Scenario #7 Output: Modeled mean sediment concentrations **WITH** stormwater (ug/kg)

West	0.866	2.770	0.000	56.698	1.733	5.330	3.466	1.979	0.213	6.396	1.066	0.433
Center	0.000	0.228	0.000	0.000	0.000	0.729	5.016	0.547	0.426	0.241	0.000	0.456
East	0.476	0.693	0.000	1.008	6.238	1.066	3.466	4.947	0.384	0.000	367.780	330.926
Lagoon					8.402							

QUESTION #1: How much did the sediment concentration increase when stormwater was added to the system? [Scenario #7 minus Scenario #6]

West	0	0	0	0	0	0	0	0	0	0	0	0
Center	0	0	0	0	0	0	0	0	0	0	0	0
East	0	0	0	0	0	0	0	0	0	0	0	0
Lagoon					0							

**NOTE:** In actuality, these numbers are >0 but are so small they round to zero. However, because there is considerable +/- uncertainty, they should not be treated as absolutes.

### TISSUE CONCENTRATION

Model Input: The model run starts with fish tissue at 0 ug/kg.

Scenario #6 Output: Modeled average tissue concentration **WITHOUT** stormwater (ug/kg)

West	7.22	10.41	5.90	92.22	8.39	13.90	11.27	8.62	5.92	15.63	7.12	7.35
Center	4.45	4.84	4.44	4.40	4.44	5.55	12.12	5.18	4.97	4.67	4.39	2.48
East	6.64	7.01	5.87	7.47	15.29	7.42	11.21	13.63	6.18	5.42	591.80	520.38
Lagoon					13.51							

Scenario #7 Output: Modeled average tissue concentration **WITH** stormwater (ug/kg)

West	7.45	10.73	6.26	94.65	9.35	15.14	11.99	9.68	6.79	16.48	8.32	8.71
Center	4.43	4.77	4.40	4.40	4.38	5.49	12.25	5.23	4.97	4.68	4.31	2.45
East	6.84	7.27	6.06	7.55	15.62	7.65	11.44	13.64	6.72	9.52	581.87	554.07
Lagoon					18.69							

QUESTION #2: How much did the fish tissue concentration increase when stormwater was added to the system? [Scenario #7 minus Scenario #6]

West	0.23	0.32	0.36	2.43	0.96	1.24	0.73	1.06	0.87	0.85	1.20	1.36
Center	-0.02	-0.07	-0.04	-0.01	-0.06	-0.06	0.14	0.05	-0.01	0.02	-0.08	-0.04
East	0.20	0.25	0.18	0.07	0.33	0.23	0.23	0.01	0.53	4.10	-9.93	33.69
Lagoon					5.18							

QUESTION #3: What percentage of the modeled fish tissue concentration can be attributed to stormwater? [Question #2 divided by Scenario #7]

West	3.11%	2.94%	<b>5.75%</b>	2.57%	<b>10.29%</b>	<b>8.22%</b>	<b>6.07%</b>	<b>10.94%</b>	<b>12.77%</b>	<b>5.16%</b>	<b>14.43%</b>	<b>15.61%</b>
Center	-0.41%	-1.46%	-0.96%	-0.14%	-1.29%	-1.08%	1.10%	0.91%	-0.10%	0.36%	-1.85%	-1.58%
East	2.97%	3.48%	2.99%	0.99%	2.14%	2.99%	1.98%	0.11%	<b>7.96%</b>	<b>43.04%</b>	-1.71%	<b>6.08%</b>
Lagoon					<b>27.73%</b>							

**BOLD > 5%**

**NOTE:** Several of the food web model parameters are expressed as uniform random variables, meaning their value is not fixed and changes with every iteration of the model. For this reason, and because of unexpressed uncertainty, anything less than a ~5% difference should not be considered meaningful.

## MODEL RESULTS SUMMARY

The model is set up for PCB 118. However, the LWG data only includes PCB 106&118, so we used those values (i.e., treated them as if they were PCB 118) for calculating stormwater loads.

The data below is arranged to coincide with the 37 model segments, as shown here:

West	1	4	7	10	13	16	19	22	25	28	31	34
Center	2	5	8	11	14	17	20	23	26	29	32	35
East	3	6	9	12	15	18	21	24	27	30	33	36
Lagoon	37											
RM 12.0	RM 10.4	RM 10.0	RM 9.4	RM 8.3	RM 7.5	RM 6.85	RM 6.05	RM 5.35	RM 4.7	RM 4.05	RM 3.4	RM 1.8

## SEDIMENT

Starting with clean sediments and upstream flow being the only source of PCBs, how much did the sediment concentration increase when stormwater was added to the system? [Scenario #1 and #2]

West	0	0	0	0	0	0	0	0	0	0	0	0
Center	0	0	0	0	0	0	0	0	0	0	0	0
East	0	0	0	0	0	0	0	0	0	0	0	0
Lagoon	0											

NOTE: In actuality, these numbers are >0 but are so small they round to zero. However, because there is considerable +/- uncertainty, they should not be treated as absolutes.

## FISH TISSUE

What percentage of the modeled fish tissue concentration can be attributed to stormwater when stormwater and upstream are the only sources?

[Scenario #1 and #2]

West	0.30%	4.85%	<b>6.41%</b>	<b>14.41%</b>	<b>14.85%</b>	<b>13.86%</b>	<b>14.48%</b>	<b>14.24%</b>	<b>13.78%</b>	<b>13.15%</b>	<b>16.16%</b>	<b>16.85%</b>
Center	1.04%	-1.45%	-2.02%	0.17%	-0.11%	-0.25%	0.60%	-0.55%	-1.97%	-0.23%	-0.80%	-1.02%
East	2.56%	0.79%	3.75%	2.85%	3.74%	4.90%	<b>5.92%</b>	3.84%	<b>8.51%</b>	<b>41.50%</b>	<b>52.77%</b>	<b>53.48%</b>
Lagoon	<b>98.39%</b>											

What percentage of the modeled fish tissue concentration can be attributed to stormwater when sediment concentration throughout the harbor is set at a hypothetical clean up value? [Scenario #4 and #5] [In an attempt to represent what the average sediment concentration in the harbor would be if "hot spots" were cleaned up, the initial total concentration in sediment for each model segment was derived by averaging the 90th percentile of the values in all 105 model segments.]

West	-1.17%	2.19%	2.59%	<b>9.47%</b>	<b>9.47%</b>	<b>7.37%</b>	<b>11.01%</b>	<b>9.58%</b>	<b>6.06%</b>	<b>8.17%</b>	<b>8.81%</b>	<b>9.51%</b>
Center	-0.50%	1.56%	0.46%	1.44%	0.81%	-1.92%	-0.63%	-0.90%	0.40%	-1.21%	1.45%	0.66%
East	1.18%	-0.60%	1.45%	2.09%	1.19%	2.05%	3.66%	2.11%	2.70%	<b>26.86%</b>	<b>39.06%</b>	<b>42.34%</b>
Lagoon	<b>52.52%</b>											

What percentage of the modeled fish tissue concentration can be attributed to stormwater when sediment concentrations are set at currently observed levels? [Scenario #6 and #7]

West	3.11%	2.94%	<b>5.75%</b>	2.57%	<b>10.29%</b>	<b>8.22%</b>	<b>6.07%</b>	<b>10.94%</b>	<b>12.77%</b>	<b>5.16%</b>	<b>14.43%</b>	<b>15.61%</b>
Center	-0.41%	-1.46%	-0.96%	-0.14%	-1.29%	-1.08%	1.10%	0.91%	-0.10%	0.36%	-1.85%	-1.58%
East	2.97%	3.48%	2.99%	0.99%	2.14%	2.99%	1.98%	0.11%	<b>7.96%</b>	<b>43.04%</b>	-1.71%	<b>6.08%</b>
Lagoon	<b>27.73%</b>											

BOLD > 5%

NOTE: Several of the food web model parameters are expressed as uniform random variables, meaning their value is not fixed and changes with every iteration of the model. For this reason, and because of unexpressed uncertainty, anything less than a ~5% difference should not be considered meaningful.